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# INFLUENCE OF CONSUMER'S BACKGROUND ON PRODUCT PERCEPTION

M. Perez Mata, S. Ahmed-Kristensen and P. B. Brockhoff

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## 1. Introduction

Over the last years, a large amount of attention has concentrated on understanding consumers as a way to target their needs and demands in a better and more accurate way. The design field has focused on understanding consumers' emotional needs and therefore researchers have started to investigate what people perceive from their interaction with products [Norman 2004]. The objective was to use this knowledge to generate new designs that appealed to their target consumers and hence stood out from the many competitors in the market. Many methodologies have emerged to support the process to design targeting consumer's preferred perceptions. Some approaches first identify the physical attributes of a product that influence consumers' perception; then provide a set of guidelines to be considered when generating a design to be perceived in a specific way [Van Bremen et al. 1998], [Schütte and Eklund 2005], [Tsai et al. 2006], [Achiche and Ahmed-Kristensen 2011]. Other approaches directly involve the consumer in the generation of the product's final form, for example by first defining the perception to achieve with the product and then allowing the consumer to interact with a computer software until he or she reaches the product form they expect to have for the defined perception [Yanagisawa and Fukuda 2005]. Some authors have found cultural differences in the understanding of product properties, particularly the meanings associated to colours [Crozier 1996], [Ou et al. 2004]. However, most of the suggested methodologies focus upon understanding the influence of altering the physical properties of the products, i.e. the aesthetics, to obtain more appealing products and very little attention is given to the background of the participants and the possible effects on the perception of design.
The aim of this research was to understand if the background of consumers (i.e. country of origin, age, gender etc.) influenced product perception, and if so, understand how designers could use that information to tailor products specifically to the background of their consumers. Two more specific sub-aims are presented in this study. The first sub-aim was to understand if the background of the participants influenced the *desire to own* a product. The second sub-aim was to understand if the background of the participants influenced the perception of beauty from a product. The perception of beauty of a product was studied because it was found to be a very significant variable, among others, related to the *desire to own* a vase [Perez Mata et al. 2013]. Advanced statistical models were used to analyse the data as they were seen as potentially useful tools to obtain a clearer interpretation of this influence. The paper is organized as follows: Section 2 presents the methodology, followed by section 3 where the results are explained and interpreted. Section 4 concludes and points to future research.

## 2. Methodology

This study is based upon concepts of vases from a Danish design-driven company based on the Scandinavian design philosophy. The concepts of the vases were produced by professional industrial designers (predominantly Scandinavian). The designers were given the brief to create an organic and feminine vase. The designers proposed several concepts and the company was responsible to decide which one would be manufactured and sold. From previous research it was found that it is difficult for users to assess products for their aesthetics if they are unsure of the functionality or usability of the product [Ahmed and Boelskifte 2006]. Hence, the vases were selected as they are products with relatively simple functionality (and usability) and with high aesthetical appeal.

### 2.1 Data collection

The dataset is the same as the one used in Perez Mata et al. [2013] where the aim was to find relationships between: 1) the *desire to own* a product, 2) the adjectives describing that product and 3) the product form (or geometry). Results from that study are two. The first relates the *desire to own* a product with adjectives beautiful, expensive, elegant and exciting. The second is a set of design guidelines that link the adjectives with product forms. Hence, guiding designers when creating the external appearance of products to target specific perceptions.
Data was collected via a survey with 11 vases through an online social network. A total of 97 participants undertook the survey which took between 15 to 20 min. to complete. However, only 71 participants answered all 126 questions and only these are analysed in this paper. In the survey, participants were asked to give information about their background namely: the country that they were from, age, gender, if they had design background and the style that they most closely associated themselves with. For the style question they were given the following options to select between (Scandinavian, Minimalistic, Romantic/French inspired, Country/Traditional and others), these styles were selected as they were defined by the company. The participants were asked to rate the perceptions of each of the 11 vase concepts (see Figure 1) for ten selected pairs of opposite adjectives (summarised in Table 1). The adjectives were developed based on prior work by one of the authors [Ahmed and Boelskifte 2006], [Achiche and Ahmed 2008]. Semantic Differential scales (SD scales) [Osgood et al. 1957] with seven levels were used to extract the emotional information from participants regarding the vases (see example in Table 2).


**Figure 1. Images of the 11 vase concepts ordered from lower to higher *desire to own***

The participants were also asked whether they had a *desire to own* the product, hence allowing the relationship between the *desire to own* the product and the perceptions evoked from the product to be investigated, for this question a three point SD scale was employed: no (-1), maybe (0), yes (+1). The ownership question was based on the intention of participants to own a product (and no information regarding the cost of the product was presented), which can differ from actual purchase.

**Table 1. The ten selected pairs of opposite adjective used to assess the perception of vases**

| | |
|---|---|
| 1. Ugly / Beautiful | 6. Clumsy / Elegant |
| 2. Aggressive / Passive | 7. Feminine / Masculine |
| 3. Cheap / Expensive | 8. Youthful / Mature |
| 4. Common / Uncommon | 9. Dynamic / Static |
| 5. Dull / Exciting | 10. Organic / Artificial |

**Table 2. Example of a SD scale with seven levels for adjective pair ugly / beautiful**

| Very Ugly | Quite Ugly | Slightly Ugly | Neutral | Slightly Beautiful | Quite Beautiful | Very Beautiful |
|---|---|---|---|---|---|---|
| -3 | -2 | -1 | 0 | 1 | 2 | 3 |

Some physical properties of the vases were measured (i.e. the number of straight lines, of curved lines, of acute angles, etc., were counted) allowing the relationship between adjectives describing the products and product properties to be investigated. Straight and curved lines, acute and obtuse angles, and curved and sharp corners are properties based on previous research [Van Bremen et al. 1998], [Hsiao and Chen 2006], [Achiche and Ahmed-Kristensen 2011]. While symmetry planes, visual gravity point, complexity (i.e. no. of independent modules), vertical or horizontal vase, brilliant or dull vase, and transparent or solid vase were properties originally considered for this study. All the properties were then converted into ratios, using the equations presented in Perez Mata et al. [2013]. Both, adjective variables and physical product properties, were summarized in fewer variables with the help of Principal Component Analysis (PCA). From that PCA, two Principal Components (PC) were taken for the adjectives and two for the physical properties of the vases (Table 4 shows a description).

**Table 3. Definition of the Principal Components for adjectives and aesthetics**

| PC1 adjectives | PC2 adjectives | PC1 aesthetics | PC2 aesthetics |
|---|---|---|---|
| Beautiful<br>Expensive<br>Elegant<br>Feminine<br>Common | Mature<br>Static<br>Passive<br>Dull | High gravity point<br>Cold colour<br>Brilliant<br>Vertical<br>High brightness<br>Irregular | Complex<br>Chroma<br>Curved corners<br>Acute angles<br>Straight lines |

The data matrix contains 71 participants x 11 vases = 781 observations (data points). The 12 variables were: *desire to own*, vase no., PC1adjs, PC2adjs, PC1aesth, PC2aesth, country, age, gender, design background and style.

### 2.2 Data analysis

The background information about the participants can be summarized as follows. The majority of the participants were mainly from Denmark (55%) followed by other European countries (with a 22,5%). There were as many participants with design background (48%) as without (52%). Most of the participants were between 30 to 39 years old (39%) followed by age group 20 to 29 (31%). There were more males than females (62% versus 38%). The style had the highest dispersion: the majority defined their style as Scandinavian (32%) and Minimalistic (27%), followed by other style (26%).

#### *2.2.1 The LmerTest package*

Methods to analyse preference data vary from widespread procedures such as simple ANOVA to other more sophisticated ones like linear mixed models. Mixed linear models can analyse complex datasets and can be seen as an extended ANOVA providing a number of added benefits to a simple ANOVA. First, it can handle missing observations and incomplete consumer preference data. Second, it can handle more complex structured data (i.e. more variables) and bigger datasets. And third, it offers more accurate results when the independent variables are a mix of categorical and quantitative effects. The problem with this model approach is the complexity of the calculations and the results. Researchers need high level of statistical expertise to identify which models to use and which results to interpret [Kuznetsova et al. 2013].

The statistics tool chosen to analyse the data of the vases was the R-package *lmerTest,* an open source package for the R-software which among other things can perform automated complex mixed modelling analyses [Kuznetsova et al. 2013b]. The *lmerTest* packgage is using the generic mixed model R-package *lme4*, [Bates et al. 2013] and can be accessed and downloaded freely from http://www.r-project.org/. The analyses were performed using RStudio, which has a friendlier interface than R itself, although it uses the computational power of the latter. Mixed models were selected over the traditional simple ANOVA approach due to the generation of prediction models able to account correctly for random samples. Simple ANOVA does not consider random effects, which means that the results obtained by that method are only valid within the elements analysed (in this case: the population of vases chosen). It is not possible to explain other vases outside the dataset. Mixed models combine the fixed effects from the ANOVA analysis with the random effects. The benefit of using mixed models was that it provided more accurate information regarding the uncertainty of variables. The disadvantage was the high complexity of the model that made data handling and the communication of results a challenge [Kuznetsova et al. 2013].

The building of a mixed model required a careful consideration of which effects to consider as random and which to consider as fixed. As a rule of thumb, all effects that had been randomly sampled should be considered random. In the vase case, participants were considered random effects because one is interested in the whole population of consumers rather than just the ones that were surveyed. The same applied to the vases. It was of interest to be able to explain all vases and not just the 11 ones of this study. The next important question involved the selection of model approach. In principle, one would like to have a model with all the possible effects included in it, and the challenge was then to simplify and reduce the model given that variables can be too many for the amount of data available. This posed the issue of selecting which effects to remove, either random or fixed, and in what order. The *lmerTest* did this automatically by simplifying the random and the fixed effects of the mixed model separately one at a time: first the random and then the fixed [Kuznetsova et al. 2013]. It is the *step* function from the *lmerTest* package the one that performed the automated modelling of the mixed effects models. The output of the function was the best model, including p-values for the random and the fixed effects, population means or least squares means estimates (LSMEANS) and comparison test in addition to confidence intervals. The model worked best with the fewer variables it included.

## 3. Results and interpretation

To understand if the background of the participants had an influence on the *desire to own* a vase or if it influenced the perception of beauty from a vase, the *lmerTest* function described above was applied to the analysis of the two variables. The first analysis calculated which background variables were influencing the *desire to own* a vase (ownership), while the second analysis calculated the background variables influencing the perception of beauty from a vase. Table 4 summarizes the steps followed with the LmerTest.

**Table 4. LmerTest steps for the analysis of the *desire to own* and beauty from vases**

| |
|---|
| 1) LmerTest on the background properties |
| 2) LmerTest with the significant background properties from step 1 and with the PCAdjs (only for the analysis of the desire to own) and the PCAesthetics |
| 3) Post-hoc analysis of step 2 with all the significant variables |

### 3.1 Analysis of ownership

For the study of the *desire to own* a vase in relation to the background of the participants, the following variables were considered: *desire to own* (ownership), vase no., participant, country, age, gender, style, design background, PC 1 and PC 2 of the adjectives, and PC 1 and PC 2 of the aesthetics or product properties. This was for the dataset of 71 participants answering the questions for 11 vases resulting in 781 total data points (observations). From the data, it was possible to plot some initial interaction plots where the background variables were depicted against the means of ownership for all the vases. These results were used as an initial guide to understanding the data in the dataset. It was possible to find interaction between variables from the plots: lines crossing each other meant there was variability, parallel lines indicated lack of variability (meaning that the background variable did not influence the *desire to own*, see Figure 2b). For example, the plot for age group in Figure 2b was a combination of variability and non-variability. Age group 29 – 39 showed quite a different pattern on the desire to own vases, they rated lower than the other two age groups. The plots also showed when participants rated one vase higher than another. Looking at Figure 2a on the left it was possible to see that for vase 7, age group from 29 - 39 had a higher *desire to own* than age group 19 - 29. However, one cannot tell if a variable was significant or not only from this plot. For that it was necessary to obtain the tables from the *lmerTest*.

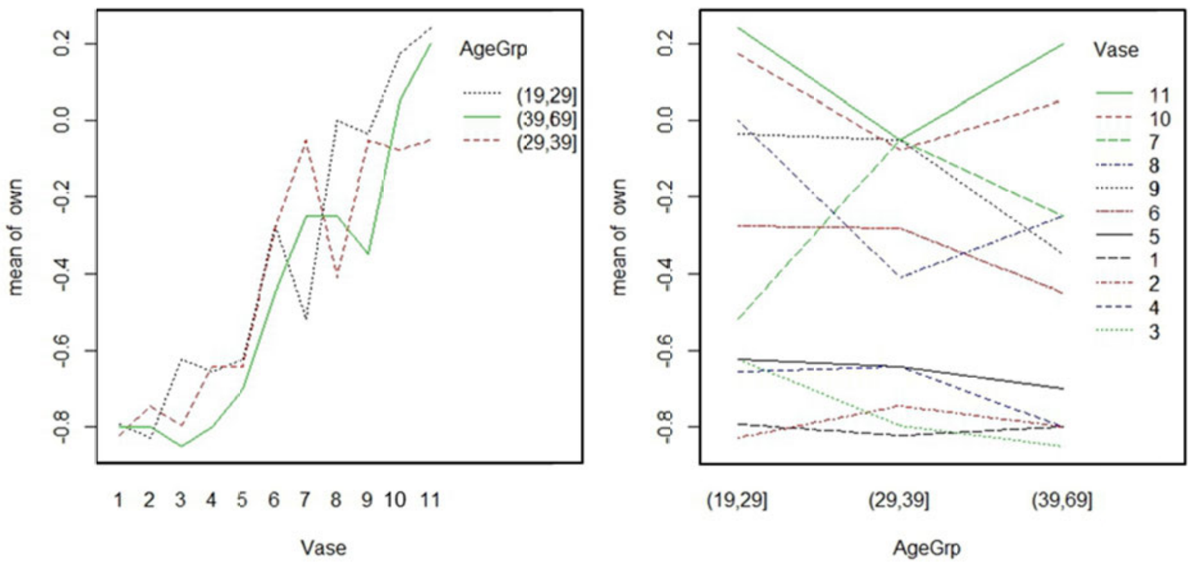


**Figure 2. a) Mean of ownership (desire to own) vs. vases for age group, b) Mean of ownership (desire to own) vs. age group for vases**

After checking that the PCs of adjectives and aesthetics (or product properties) had linear relations and not quadratic relations, the analysis proceeded with the creation of the mixed model. For the analysis of the *desire to own* a product, the first step was to apply the *lmerTest* to the background of the participants. The purpose was to find the significant background variables related to the *desire to own* a vase so they could be incorporated in the final model that included the perceptions from and properties of the product (the PC adjectives and PC aesthetics). Results from that first *lmerTest* on the background showed that participants were significant with a p-value below 0.05 for the random effects (see Table 5). While vase and Country:Vase were significant fixed effects with a p-value lower than 0.05 (see Table 6). These variables continued to the next test round, together with variable country (that was not significant individually in the test but needed to be kept as it was significant when in combination with vase). The ':' sign between variables meant there was interaction between the two, i.e. for Country:Vase, vase moderated the effect of country. This interaction meant that country alone could not explain the *desire to own* a vase, but the combination of Country and Vase may.

In the second *lmerTest*, the background variables and the interaction of product properties with background variables were considered random because one wants to explain the demographic of the consumers in general and not only the participants from the survey (see Table 7). This final model also included the PC adjectives and the PC aesthetics, as fixed effects. Results show that participants and PC2aesth:Participants are significant for the random effects (see Table 7). The meaning of this is that there are significant different levels of *desire to own* for each participant and also that there are significantly different *desire to own*-PC2aesth relations from participant to participant. The significant fixed effects were PC1adjs, PC2adjs, PC1aesth and PC2aesth (see Table 8).

**Table 5. Random effects results for the initial model of *desire to own***

| Random variables | Chi.sq | Chi.DF | elim.num | p-value |
|---|---|---|---|---|
| Participant | 26.661 | 1 | Keep | 0 |

**Table 6. Fixed effects results for the initial model of *desire to own* (significant in bold)**

| Fixed variables | Sum Sq | Mean Sq | NumDF | DenDF | F-value | elim.num | p-value |
|---|---|---|---|---|---|---|---|
| Gender:Vase | 2.300 | 0.230 | 10 | 589.898 | 0.684 | 1 | 0.740 |
| DesignBackground:Vase | 2.709 | 0.271 | 10 | 599.897 | 0.772 | 2 | 0.656 |
| DesignBackground | 0.022 | 0.022 | 1 | 58.982 | 0.066 | 3 | 0.798 |
| Gender | 0.321 | 0.321 | 1 | 59.985 | 1.536 | 4 | 0.220 |
| AgeGroup:Vase | 8.712 | 0.436 | 20 | 609.895 | 1.2667 | 5 | 0.194 |
| AgeGroup | 0.448 | 0.224 | 2 | 60.981 | 0.762 | 6 | 0.471 |
| Style:Vase | 16.508 | 0.413 | 40 | 629.892 | 1.272 | 7 | 0.126 |
| Style | 0.904 | 0.226 | 4 | 62.980 | 0.503 | 8 | 0.734 |
| Country | 1.1595 | 0.387 | 3 | 66.981 | 1.209 | keep | 0.313 |
| **Vase** | **79.022** | **7.902** | **10** | **669.885** | **19.025** | **keep** | **0.000** |
| **Country:Vase** | **18.297** | **0.610** | **30** | **669.885** | **1.797** | **keep** | **0.006** |

**Table 7. Random effects results for the final model of *desire to own* (significant in bold)**

| Random variables | Chi.sq | Chi.DF | elim.num | p-value |
|---|---|---|---|---|
| PC1adjs:Participant | 0.000 | 1 | 1 | 1.000 |
| Vase | 0.803 | 1 | 2 | 0.370 |
| PC1aesthetics:Participant | 1.071 | 1 | 3 | 0.301 |
| PC2adjs:Participant | 1.556 | 1 | 4 | 0.212 |
| Vase:Country | 2.184 | 1 | 5 | 0.139 |
| **Participant** | **27.007** | **1** | **keep** | **0.000** |
| **PC2aesthetics:Participant** | **12.056** | **1** | **keep** | **0.001** |

**Table 8. Fixed effects results for the final model of *desire to own* (significant in bold)**

| Fixed variables | Sum Sq | Mean Sq | Num DF | DenDF | F-value | elim.num | p-value |
|---|---|---|---|---|---|---|---|
| Country:PC2aesthetics | 1.616 | 0.539 | 3 | 524.900 | 1.651 | 1 | 0.177 |
| Country:PC1adjs | 0.644 | 0.215 | 3 | 128.931 | 1.193 | 2 | 0.315 |
| Country:PC1aesthetics | 1.184 | 0.395 | 3 | 631.952 | 0.847 | 3 | 0.468 |
| Country:PC2adjs | 2.370 | 0.790 | 3 | 658.321 | 2.238 | 4 | 0.083 |
| Country | 1.184 | 0.395 | 3 | 66.980 | 1.209 | 5 | 0.313 |
| **PC1adjs** | **37.929** | **37.929** | **1** | **635.889** | **64.319** | **keep** | **0.000** |
| **PC2adjs** | **5.43635** | **5.436** | **1** | **635.889** | **30.168** | **keep** | **0.000** |
| **PC1aesthetics** | **5.014** | **5.014** | **1** | **635.889** | **20.296** | **keep** | **0.000** |
| **PC2aesthetics** | **1.6752** | **1.6752** | **1** | **544.711** | **5.103** | **keep** | **0.024** |

To interpret these results and put them in relation to the *desire to own* a product, a post-hoc analysis was made including only the significant random and fixed variables of this last test. Results of the post-hoc analysis showed that PC1 adjectives, PC2 adjectives and PC1 aesthetics were significant (see Table 9). The sign of the estimate column indicated that PC1adjs (a combination of beautiful, expensive, elegant, feminine and common) was positively correlated with the *desire to own* a vase.

PC2adjs (a combination of mature, static, passive and dull) and PC1 aesthetics (a combination of high gravity point, cold colour, brilliant, vertical, high brightness and irregular) were negatively correlated to the *desire to own*; i.e. those adjectives or product properties negatively influenced the *desire to own*.

**Table 9. Post-hoc analysis results for *desire to own* (significant in bold)**

| Variables | Estimate | Std. Error | t-value | p-value |
|---|---|---|---|---|
| (Intercept) | -0.399 | 0.042 | -9.469 | 0.000 |
| **PC1adjs** | **0.184** | **0.039** | **4.765** | **0.003** |
| **PC2adjs** | **-0.094** | **0.029** | **-3.263** | **0.017** |
| **PC1aesthetics** | **-0.064** | **0.024** | **-2.676** | **0.037** |
| PC2aesthetics | 0.074 | 0.053 | 1.396 | 0.208 |

The conclusion from the analysis of the *desire to own* was that the background of participants did not influence the *desire to own* a vase. But PC1 and PC2 of the adjectives describing the perception of vases and PC1 aesthetics of the physical properties of the vases did influenced the *desire to own*.

### 3.2 Analysis of beautiful

The adjective beautiful was also analysed since it was found to be highly correlated to the *desire to own* a vase in Perez Mata et al. [2013], and although it is not the only influencing parameter in the *desire to own* a product, it is the one with highest correlation. The analysis of beautiful, although following the same methodology, included a different set of variables. The background variables of the participants were kept but the principal components for the adjectives were removed from the analysis. This left a model that analysed the influence of the background of the participants and of the physical properties of the vases on the perception of beauty. The vases were again ordered by increasing beauty, i.e. in order of lowest to highest perception of beauty, which differs from the order in Figure 1.

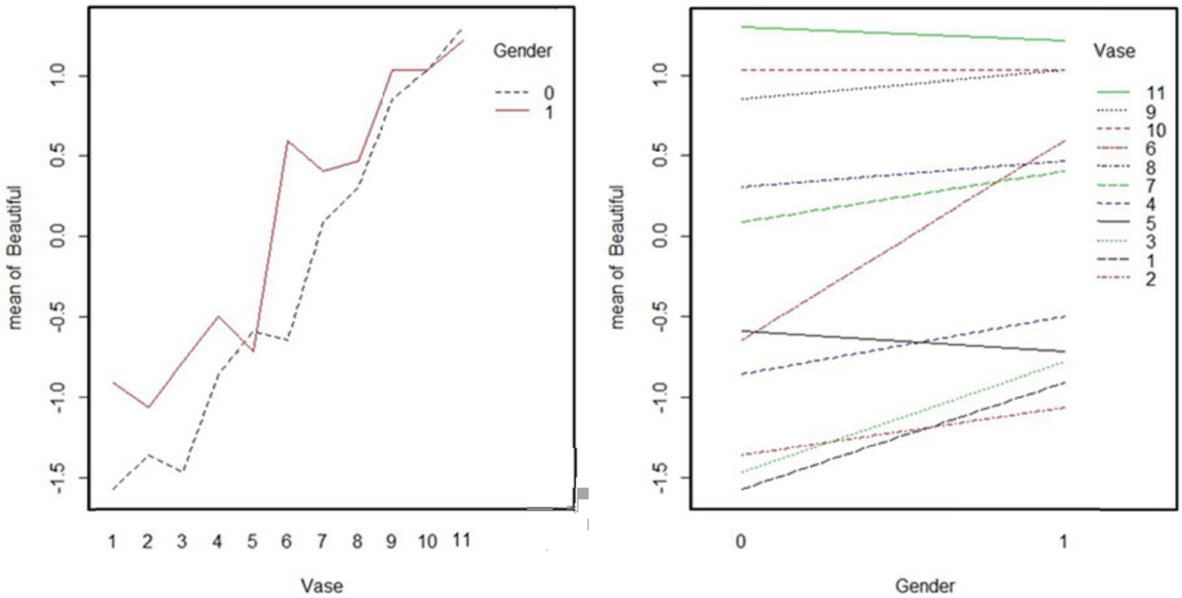


**Figure 3. a) Mean of ownership (desire to own) vs. vases for gender, b) Mean of ownership (desire to own) vs. gender for vases (0 = male, 1 = Female)**

Initial interaction plots from the data presented the background variables against the mean of ownership. The lines in Figure 3 b indicated lack of variability when the lines were parallel (i.e. the variable did not influence the perception of beauty), while there was variability when the lines crossed each other (i.e. the variable influenced the perception of beauty); for gender it was a combination of both. From Figure 3 a and b, women (value 1 in the plot) were seen to rate vases higher than men (value 0 in the plot) for almost all vases, and specially for vase 6 there was a big mismatch between both genders. This was a general pattern in the data except for a few vases were men scored equal or higher than women. However, the *lmerTest* was necessary to find out if this pattern in the data was significantly influencing the perception of beauty. As before, the first *lmerTest* was employed to reduce the number of the background variables that were consider for the final mixed model by removing those that were not significant. The results from that initial *lmerTest* showed that participants are significant for the random effects (see Table 10). Gender, vase and Country:Vase, were significant for the fixed effects (see Table 11). The variables marked with kept in the elimination number column were used in the final *lmerTest*, the one involving the analysis of the significant background variables and the PC of the properties of the product (i.e. PC1 and 2 aesthetics).

**Table 10. Random effects results for the initial model of beautiful**

| Random variables | Chi.sq | Chi.DF | elim.num | p-value |
|---|---|---|---|---|
| Participant | 16.456 | 1 | Keep | 0 |

**Table 11. Fixed effects results for the initial model of Beautiful (significant in bold)**

| Fixed variables | Sum Sq | Mean Sq | NumDF | DenDF | F.value | elim. num | p-value |
|---|---|---|---|---|---|---|---|
| Gender:Vase | 18.753 | 1.875 | 10 | 589.955 | 0.891 | 1 | 0.542 |
| DesignBackground:Vase | 16.930 | 1.693 | 10 | 599.954 | 0.910 | 2 | 0.523 |
| DesignBackground | 1.063 | 1.062 | 1 | 58.982 | 0.602 | 3 | 0.441 |
| Style:Vase | 71.115 | 1.778 | 40 | 609.953 | 1.066 | 4 | 0.365 |
| Style | 2.324 | 0.581 | 4 | 59.981 | 0.331 | 5 | 0.856 |
| AgeGroup:Vase | 44.633 | 2.232 | 20 | 649.951 | 1.264 | 6 | 0.196 |
| AgeGroup | 2.336 | 1.168 | 2 | 63.977 | 0.695 | 7 | 0.503 |
| Country | 4.321 | 1.440 | 3 | 65.977 | 0.655 | keep | 0.583 |
| **Gender** | **6.675** | **6.675** | **1** | **65.977** | **4.009** | **keep** | **0.049** |
| **Vase** | **636.036** | **63.604** | **10** | **669.949** | **23.283** | **keep** | **0.000** |
| **Country:Vase** | **85.497** | **2.850** | **30** | **669.949** | **1.601** | **keep** | **0.023** |

In the second *lmerTest*, the significant background variables and the interaction of product properties with the background variables were considered random because one wants to explain the background of the consumers in general and not only the participants from the survey. The product properties were included as fixed effects in the model. The results of the final model for random and fixed effects shows that vase, participants and PC2 aesthetics:participants were significant for the random effects (see Table 12). The meaning of this was that there are significant different levels of *beautiful* for each vase and for each participant. There were also significantly different *beautiful*-PC2aesthetics relations from participant to participant. Gender and PC2 aesthetics were significant for the fixed effects (see Table 13). To interpret these results and put them in relation to the perception of beauty from a vase, an additional post-hoc analysis intended to ease the interpretation of the significance of the variables was performed, including only the significant random and fixed effects. Results of this final analysis showed that gender was the only significant background variable that could explain changes in the perception of beauty from a vase (see Table 14). Gender had a significant positive value, that is, the females rated the vases as more beautiful than men with a value of 0.287 (taken from the estimate column) on the scale of beautiful (see Table 2). Therefore, the pattern seen in Figure 3 is confirmed as significant. PC2 aesthetics (a combination of complex, low chroma, curved corners, acute angles and straight lines) was found to be negatively correlated to beautiful.

**Table 12. Random effects results for the final model of beautiful (significant in bold)**

| Random variables | Chi.sq | Chi.DF | elim.num | p-value |
|---|---|---|---|---|
| Vase:Gender | 0.000 | 1 | 1 | 1.000 |

| | | | | |
|---|---|---|---|---|
| PC1aesthetics:Participant | 0.261 | 1 | 2 | 0.609 |
| **Vase** | **18.645** | **1** | **Keep** | **0.000** |
| Vase:Country | 3.431 | 1 | Keep | 0.064 |
| **Participant** | **16.352** | **1** | **Keep** | **0.000** |
| **PC2aesthetics:Participant** | **10.563** | **1** | **Keep** | **0.001** |

**Table 13. Fixed effects results for the final model of beautiful (significant in bold)**

| Fixed variables | Sum Sq | Mean Sq | NumDF | DenDF | F.value | elim.num | p-value |
|---|---|---|---|---|---|---|---|
| Country:PC2aesthetics | 0.038 | 0.013 | 3 | 34.173 | 0.049 | 1 | 0.985 |
| Country:PC1aesthetics | 2.984 | 0.995 | 3 | 26.916 | 0.705 | 2 | 0.558 |
| Country | 3.025 | 1.008 | 3 | 44.216 | 0.516 | 3 | 0.674 |
| Gender:PC1aesthetics | 0.803 | 0.803 | 1 | 630.650 | 0.339 | 4 | 0.560 |
| PC1aesthetics | 0.186 | 0.186 | 1 | 7.957 | 0.113 | 5 | 0.745 |
| Gender:PC2aesthetics | 1.482 | 1.482 | 1 | 70.185 | 0.791 | 6 | 0.377 |
| **Gender** | **6.623** | **6.623** | **1** | **69.918** | **4.476** | **keep** | **0.038** |
| **PC2aesthetics** | **24.022** | **24.022** | **1** | **9.900** | **16.407** | **keep** | **0.002** |

**Table 14. Post-hoc analysis results for beautiful (significant in bold)**

| Variables | Estimate | Std. Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | -0.204 | 0.192 | -1.062 | 0.309 |
| **Gender** | **0.287** | **0.136** | **2.116** | **0.038** |
| **PC2aesthetics** | **-0.446** | **0.110** | **-4.051** | **0.002** |

The conclusion from this analysis was that gender did have an influence in the evaluation of the beauty of a vase, with females rating the vases 0.287 higher than males. However, that difference was within one category of the scale of beautiful (see Table 2). Hence, although higher, it was not enough to make female participants belong to another point in the beautiful scale.

## 4. Conclusion

The purpose of this paper was to investigate the influence of the background of the participants on two variables: the *desire to own* vases and the perception of beauty from vases. Beauty was investigated as it was found to be highly correlated to the *desire to own*. Previous studies had investigated the relationships between the perception of a product and the product properties; and also the relationships between the perception of a product and the *desire to own* it. This study built on those approaches and aimed to investigate relationships also to the background of the participants. This was done by applying the *lmerTest* on the data from 71 participants.

Results have revealed that the background of the participants, in particular gender, does influence the perception of beauty from vases. But the background of participants does not influence the *desire to own* them. Results also showed that the principal components of adjectives and aesthetics have an influence on the *desire to own* and the beauty of vases. PC1 adjectives (a combination of beautiful, expensive, elegant, feminine and common), PC2 of the adjectives (a combination of mature, static, passive and dull) and PC1 aesthetics (a combination of high gravity point, cold colour, brilliant, vertical, high brightness and irregular) influenced the *desire to own* vases; while PC2 aesthetics (a combination of complex, low chroma, curved corners, acute angles and straight lines) influenced the perception of beauty. The implications of this are that if we had rules connecting the perceptions from products with the geometry of products, designers could design products that influenced the *desire to be owned* and that were perceived as beautiful, all of it transcending the background of the participants, i.e. the design of a product can influence ownership.

The participants' background was limited to a few known factors (age, gender, style, country and design background). Further work including more background variables in the analysis could be of interest. It is acknowledged that the results from this paper are specific to vases but it is believed that the method can be applied to other product categories. Further work should focus on validation, on the analysis of other perceptions from vases and in extending the analysis to other product categories.


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